

COMPLETE LISTING OF THE CLAIMS

The following lists all of the claims that are or were in the above-identified patent application. The status identifiers respectively provided in parentheses following the claim numbers indicate the current statuses of the claims.

Claims 1- 6 (Canceled)

7. (Previously Presented) A semiconductor device comprising:

a substrate of a first conductivity type;

a gate structure in a plurality of trenches in the substrate, wherein in each of the trenches, the gate structure comprises a conductive gate surrounded by an insulating material that has a first thickness at a sidewall of the trench and a second thickness at a bottom of the trench, the second thickness being greater than the first thickness;

a first region of a second conductivity type adjacent to at least one of the trenches, the first region extending to a first depth in the substrate and including a channel region adjacent to the trenches;

a second region of the second conductivity type, wherein the second region is in electrical contact with the first region, and the second region extends to a second depth that is deeper than the first depth and shallower than the trenches; and

a third region of the first conductivity type atop the first region, wherein a voltage on the conductive gate controls a current flow from the third region through the first region to an underlying portion of the substrate, wherein

the substrate comprises a layer in which the trenches reside, the layer having a graded dopant profile such that a concentration of dopants of the first conductivity increases with depth in the layer.

8. (Previously Presented) The semiconductor device of claim 7, wherein the substrate comprises a series of implantations having varying depths and dopant concentrations such that the concentrations of the dopants of the first conductivity increase with depth in the substrate.

9. (Previously Presented) A semiconductor device comprising:

a substrate of a first conductivity type;

a gate structure in a plurality of trenches in the substrate, wherein in each of the trenches, the gate structure comprises a conductive gate surrounded by an insulating material that has a first thickness at a sidewall of the trench and a second thickness at a bottom of the trench, the second thickness being greater than the first thickness;

a first region of a second conductivity type adjacent to at least one of the trenches, the first region extending to a first depth in the substrate and including a channel region adjacent to the trenches;

a second region of the second conductivity type, wherein the second region comprises a series of implantations at varying depths, is in electrical contact with the first region, and extends to a second depth that is deeper than the first depth and shallower than the trenches; and

a third region of the first conductivity type atop the first region, wherein a voltage on the conductive gate controls a current flow from the third region through the first region to an underlying portion of the substrate.

Claims 10- 27 (Canceled)